



Institute for Empirical Research in Economics
University of Zurich

Working Paper Series
ISSN 1424-0459

Working Paper No. 317

**The Emergence of Information Sharing in Credit
Markets**

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April 2007

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March 2007

Abstract

We examine how asymmetric information and competition in the credit market affect voluntary information sharing between lenders. We study an experimental credit market in which information sharing can help lenders to distinguish good borrowers from bad ones, because borrowers may exogenously switch locations. Lenders, however, are also engaged in spatial competition, and lose market power by sharing information with close competitors. Our results suggest that more asymmetric information in the credit market increases information sharing behavior significantly. Stronger competition between lenders reduces information sharing, but its impact seems to be only of second order importance.

JEL-Classifications: C92, G21, D82

Keywords: Credit Market, Information Sharing, Spatial Competition, Adverse Selection

*We thank Steven Ongena as well as seminar participants at the University of Zurich and HEC Lausanne for helpful comments. We further thank Franziska Heusi for providing excellent research assistance. Zehnder gratefully acknowledges financial support by the national center of competence in research on “Financial Valuation and Risk Management”. The national centers in research are managed by the Swiss National Science Foundation on behalf of the federal authorities. The views expressed in this paper do not necessarily reflect those of the Swiss National Bank.

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1 Introduction

The systematic use of credit reports in assessing loan applications is one of the most remarkable developments in modern banking. Based on the information derived from credit reports loan approvals are now often made within minutes, particularly in the consumer credit segment. Over the past 30 years the number of reports issued by credit bureaus in the United States has increased ten-fold, so that today over 3 million credit reports are issued on a daily basis (Hunt, 2005). Beyond the United States the credit reporting industry has also gone through dramatic developments. Examining data for 129 countries, Djankov et al. (forthcoming) show that the number of countries with a public credit registry increased from 21% in 1978 to 53% in 2003, while the number of countries with at least one private credit bureau increased from 16% to 41% over the same period.

The rapid increase in private credit bureaus around the world is astonishing, given that these rely on voluntary information sharing between often competing banks. Unlike public credit registries which are implemented by the state, and to which lenders must contribute information, private credit bureaus are initiated by the private sector and involve voluntary information exchange. Contributing information to a private credit bureau involves a trade-off for lenders. On the one hand, they benefit from information sharing as it helps them to select good from bad applicants (Pagano and Jappelli, 1993). Moreover, information sharing can overcome moral hazard of borrowers, motivating them to exert higher effort in projects (Vercammen, 1995; Padilla and Pagano, 2000, and repay loans (Klein, 1992). On the other hand, sharing information with other lenders may expose banks to increased competition because they release private information about their existing clients. Banks may therefore be wary of sharing information in competitive credit markets, and may be particularly reluctant to share information with close competitors (Pagano and Jappelli, 1993).¹ Historical records show that credit reporting in the United States did initially emerge among non competing lenders (Olegario, 2003). Recent anecdotal evidence from Russia also demonstrates the reluctance of banks to participate in the same credit bureau as their rivals. After the introduction of a law in 2005, forcing all lenders to join at least one bureau, many lenders set up their own credit bureaus, in order to avoid sharing information with competitors.² However, strong competition has not generally inhibited the emergence of private credit bureaus. It is striking that many bureaus collect and distribute information for the consumer credit market, which is arguably one of the most competitive retail segments (Hunt, 2005; San José Riestra, 2002).

¹In a recent paper Bouckaert and Degryse (2006) show that the incentives to unilaterally disclose information on default behavior also depends on lenders' inherent market power.

²See http://www.interfax.ru/e/B/0/0.html?id_issue=11383470.

It appears therefore that, at least in consumer credit, the benefits of sharing information outweigh the fears of increased competition.

In this paper we examine - in a laboratory credit market - how adverse selection and lender competition affect voluntary information sharing between lenders. We implement an experimental credit market which is characterized by adverse selection: Lenders know that there are good and bad borrowers, but they can only identify the type of borrowers in their “home market”. Borrowers may switch their location, in which case lenders can only identify good new entrants, if they share information with lenders, which are based in other markets. The higher the probability that borrowers switch location, the more severe the problem of adverse selection, and the stronger the incentives to share information. Our credit market is also characterized by lender competition, which reduces information sharing incentives. We implement a simple form of spatial competition: Each lender has one direct competitor, and two lenders with which he does not compete at all. In such a situation lenders benefit from sharing information with non-competitors, but may lose out by sharing information with direct competitors. The advantage of our experimental approach is that we can exogenously vary both, the degree of adverse selection (i.e., borrower mobility), as well as the intensity of competition between lenders. By comparing the outcome across treatments we can therefore systematically identify how exogenous changes in information conditions and lender competition affect the emergence of information sharing in a credit market.

Our results confirm the main predictions of Pagano and Jappelli (1993): Adverse selection and lender competition both systematically affect voluntary information sharing. In treatments with higher borrower mobility full information sharing between our experimental lenders is more frequent. In contrast, in treatments with stronger lender competition, full information sharing is less frequent. As our experiment implements spatial competition between lenders, our results provide two interesting additional insights into the determinants of voluntary information sharing. First, our results show that even when full information sharing between lenders is not feasible, partial sharing emerges in which lenders exchange information with non-competitors only. Second, we find that adverse selection has a much stronger impact on information sharing behavior, than competitive conditions in the credit market. We implement two treatments in which, due to spatial competition both full and partial information sharing are sustainable in equilibrium. We find that in treatments with multiple equilibria, full information sharing arises if borrower mobility, and thus potential adverse selection is high. Moreover, if borrower mobility is low partial information sharing emerges even if lender competition is very weak.

Our findings contribute to the growing empirical literature on the role of information sharing in financial market development, by providing systematic evidence on the

determinants of voluntary information sharing. Several recent studies have demonstrated that information sharing is beneficial to credit market performance. Credit scoring models based on credit bureau data suggests that the use of credit reports allows lenders to more accurately predict loan defaults (Kallberg and Udell, 2003; Barron and Staten, 2003; Luoto et al., 2004; Powell et al., 2004). Moreover, recent experimental results indicate that information sharing disciplines borrowers to repay loans (Brown and Zehnder, 2006). Cross-country evidence, meanwhile, supports the conjecture that information sharing improves credit availability. Aggregate credit market volume is higher in countries where information sharing is more developed (Jappelli and Pagano, 2002; Djankov et al., forthcoming). Moreover, analyses of firm-level data (Galindo and Miller, 2001; Love and Mylenko, 2003; Brown et al., 2007) show that access to bank credit is easier in countries where credit bureaus or registries exist. While existing evidence confirms that information sharing between lenders is beneficial for credit market performance, there is little evidence examining the circumstances, in which credit bureaus emerge. Pagano and Jappelli (1993) show that consumer credit reporting in OECD countries is positively related to household mobility, and thus to potential adverse selection for banks. However, there is, to our knowledge, no systematic evidence on how credit market competition interacts with adverse selection in determining voluntary information sharing. Our experimental results provide a first attempt at closing this gap.

The rest of the paper is organized as follows: Part 2 presents our experimental design and our predictions. Part 3 presents our results, and part 4 concludes.

2 Experimental design

We examine the incentives of lenders to exchange information in a competitive credit market characterized by asymmetric information. Similar to Pagano and Jappelli (1993) lenders only know the type of borrowers in their home market. As there is a positive probability that borrowers switch locations, lenders may want to share information about borrowers with other lenders. However, as lenders compete for borrowers, information sharing constitutes a trade-off: Should lenders join the bureau in order to gain information on borrowers which may move to their market, or should they stay out of the bureau in order to hide good borrowers in their home market from competitors.

2.1 Credit market

Our credit market is divided into two regions, A and B , and in each region there are two sectors. Sectors $S1$ and $S2$ are in region A , sectors $S3$ and $S4$ are in region B . In each sector there is one lender ($L1, L2, L3, L4$), and four entrepreneurs ($E1-E4$ in $S1$, $E5-E8$

in $S2$, $E9$ - $E12$ in $S3$ and $E13$ - $E16$ in $S4$). Each entrepreneur requires a loan of $I = 100$ points in order to realize a project. In each region there is one good entrepreneur who yields a return of $Y_g = 300$ points from his project and three bad entrepreneurs who yield an income of $Y_b = 0$ from their project. Figure 1 displays a graphical representation of the situation in our experimental credit market.

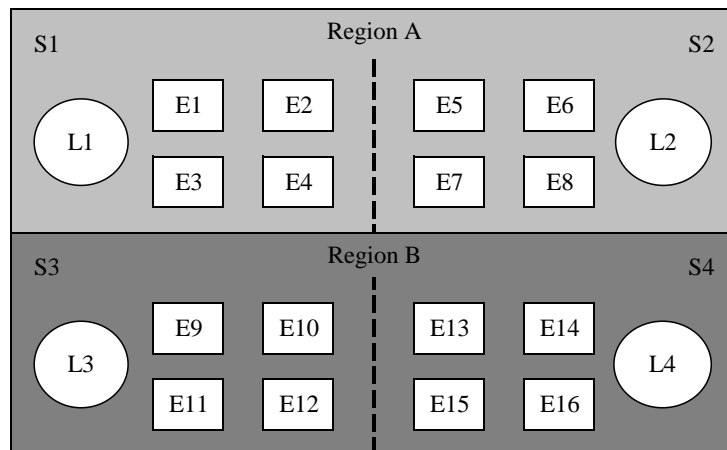


Figure 1: Structure of the Credit Market

The participants in our experiment all take the role of lenders, while entrepreneurs are simulated. The strategic interaction between our experimental lenders takes place in six phases:

In **phase 1** each lender gets to know the types of all four entrepreneurs in his home sector. Which entrepreneur is good in each sector is randomly determined at the beginning of each period. Lenders are informed which entrepreneur is good, and which three are bad by means of a color code. Lenders, do not get any information about the entrepreneurs' types in the other three sectors of the credit market.

In **phase 2** each lender decides whether to join a credit bureau or not. Lenders who are in the same region decide sequentially whether to join the credit bureau or not. In each period the “first-mover” for each region is randomly determined. Before deciding whether to join the credit bureau, the “second-mover” in each region is informed about the decision of the first-mover. Neither the first-, nor the second-mover in one region are informed about the decisions of lenders in the other region, until after they have made their own decisions. Membership of the bureau bears no cost, and information sharing is reciprocal: All members of the credit bureau get to know the type of all entrepreneurs from the home sector of all other bureau members. Non-members receive no information on entrepreneurs outside of their home sector. In return bureau members do not receive information on an entrepreneur if the lender from that sector does not join the bureau.

In **phase 3** entrepreneurs switch sectors with a probability α . If entrepreneurs switch their sector, they do so in groups, and switch to the other region. All entrepreneurs from sector $S1$ move to sector $S3$ (and vice versa) while all entrepreneurs from sector $S2$ move to sector $S4$ (and vice versa). The fact that entrepreneurs switch in groups guarantees that if they switch, there remain one good entrepreneur and three bad ones in each sector. The fact that entrepreneurs always switch regions, simplifies the strategic interaction, as lenders know that if switching occurs they can no longer access any borrower they already have information on. Whether entrepreneurs switch or not is independently determined for each market by the physical roll of a dice.

In **phase 4** each lender can make credit offers to entrepreneurs which are at this point in time situated in the same region. The size of a credit is fixed at $I = 100$ points. Each lender is endowed with funds of 200 points in each period, and can therefore make at most two credit offers. When making a credit offer the lender must specify his requested repayment $\tilde{R} \in [100, 300]$. In order to make a credit offer to a particular entrepreneur a lender must select the ID number of the entrepreneur. Lenders $B1$ and $B2$ can offer credit to any entrepreneur situated in region A. Lenders $B3$ and $B4$ can offer credit to any entrepreneur situated in region B. Our design thus implements a simple form of spatial competition: Each lender has one direct competitor, and two lenders with which he does not compete at all. Intra-regional competition in our experiment is incomplete. A credit offer to the entrepreneur situated in the home sector of the lender bears no transaction costs $c = 0$. In contrast, a credit offer to an entrepreneur in the other sector of a lender's region involves positive transaction costs of $c = T$. All credit offers are made simultaneously.

In **phase 5** each entrepreneur can accept one of the credit offers made to him. Entrepreneurs in our experiment are programmed to accept the credit offer with the lowest requested repayment. If an entrepreneur receives two credit offers with equal repayment requests he chooses that of the lender in the sector he is situated. This is common knowledge among lenders. The lenders' repayment requests are enforceable, but we assume that there is limited liability of entrepreneurs. Thus, good entrepreneurs make actual loan repayments of $R = \tilde{R}$, while bad entrepreneurs make repayments of 0.

In **phase 6** the lenders get to know the credit market outcome and their payoffs. All lenders learn the type of each entrepreneur in their region and they are informed about all credit offers made by themselves and the other lender in their region. Lenders also get to know which of their credit offers were accepted and their resulting payoff. It is common knowledge that all lender payoffs are calculated as follows:

$$\pi^L = \begin{cases} 200, & \text{if no credit offer accepted} \\ 100 + R_1 - c_1, & \text{if one credit offer accepted} \\ R_1 - c_1 + R_2 - c_2, & \text{if two credit offers accepted} \end{cases}$$

Each session of our experiment involves 12 participants and lasts 20 periods. As all participants are assigned the role of lenders, there are in each period three identical credit markets with four lenders each. Each period involves a restart of the experiment: Lenders are randomly reassigned to one of the three credit markets, and the location of the good entrepreneur in each sector of each credit market is randomly determined.

2.2 Treatments and procedures

We implement four treatments of our experiment. Treatments differ only by the probability of entrepreneurs switching α , and the transaction costs of intra-regional lending T . In order to study the individual and joint impacts of borrower mobility and lenders' market power on information sharing we vary both factors independently. We thus implement four treatments in the following two-by-two design:

Table 1: Experimental Treatments and Predictions

		Cross-sector transaction costs	
		$(T = 160)$	$(T = 60)$
Mobility	$(\alpha = .25)$	LowMobility- LowCompetition	LowMobility- HighCompetition
	$(\alpha = .75)$	HighMobility- LowCompetition	HighMobility- HighCompetition

In total we conducted 20 experimental sessions, five for each of our four treatments. All experimental subjects were volunteers and each participant could only participate in one session (i.e., each subject experienced only one of the treatments). All participants were students at the University of Zurich or the Swiss Federal Institute of Technology Zurich (ETH). The computerized experiment was programmed and conducted with the experimental software z-Tree (Fischbacher, forthcoming). A session lasted approximately ninety minutes. Subjects received a show-up fee of 10 Swiss francs (CHF) and 1 additional franc for every 150 points earned during the experiment. On average subjects earned 55 Swiss francs (1.3 CHF \approx 1 US\$ in June 2006).

To make sure that all participants fully understand the decision process and the payment structure of the game, each subject had to read a detailed set of instructions before a session was started. After reading the instructions participants had to pass a test with control questions. No session started before all subjects had correctly answered all control questions. An English version of our (originally German) instructions is provided in Appendix B.

3 Predictions

We derive our predictions by backward induction assuming that all lenders are risk-neutral. In the first step we examine the lenders' offering decisions depending on the information status in the market. In the second step we investigate under what conditions lenders are willing to voluntarily join the credit bureau. We describe the full set of pure strategy equilibria for our experiment depending on the mobility of entrepreneurs α and the degree of intra-regional competition among lenders determined by T . This then allows us to make precise predictions for each of our four treatments.

3.1 Lending

No lender will make a credit offer to an entrepreneur he knows is "bad", as he would incur a certain loss of $I = 100$ if the entrepreneur is situated in his own sector, and a loss of $100 + T$ if the entrepreneur is in the other sector of the region. Furthermore, no lender will lend to an entrepreneur of an unknown type. The expected profit of lending to an unidentified entrepreneur in the same sector is $\pi_i^L = .25 \cdot Y_g - I = -25$. The expected profit of lending to an unidentified entrepreneur in the other sector of the lenders region is consequently also negative $\pi_i^L = -25 - T$. In the following we therefore only have to consider offers to entrepreneurs that are known to be good. If a lender knows that he is the only lender in his region who is informed that a particular entrepreneur i is of the good type, he will demand the maximum repayment $\tilde{R}_i = Y_g = 300$. He does this because he knows that the entrepreneur will receive no credit offer from his competitor. In this case, the lender's profit from the contract with entrepreneur i is either $\pi_i^L = Y_g - I = 200$, if the entrepreneur is in the lender's home sector, or $\pi_i^L = 200 - T$ if the entrepreneur is in the other sector of the region. If, in contrast, both lenders in a region know that entrepreneur i is good, price competition implies that each lender makes an offer with a requested repayment $\tilde{R}_i = I + T = 100 + T$, which is the lowest profitable offer the "outside" lender can make. As, by assumption, entrepreneurs always accept the offer of the home lender in case of identical repayment requests, the lender situated in the same sector as entrepreneur i concludes a contract with him and realizes a profit of $\pi_i^L = T$.

3.2 Information sharing

In our experiment decisions to join the credit bureau are made sequentially within regions (and simultaneously across regions). Lemma 1 characterizes the best-response behavior of the second-mover lender in each region given the decision of his competitor and depending on the (unknown) behavior of the two non-competing lenders from the other region.

Lemma 1. (second-mover behavior) *i) If the first-mover lender in a region does not join the credit bureau, the second-mover lender is strictly better off by joining if at least one non-competing lender also joins. If no other lender joins, then the second-mover lender is indifferent between joining and not. ii) If the first-mover lender in a region does join the credit bureau, then the second-mover lender is better off by joining only if $(Y_g - I)(1 - \alpha) \leq (1 - \alpha + \gamma\alpha)T$, where $\gamma \in \{0; 0.5; 1\}$ is the share of non-competing lenders from the other region that join.*

Proof. see Appendix A. □

The intuition behind Lemma 1 is straightforward: i) If a lender's direct competitor is not a bureau member, information sharing can only be positive: If entrepreneurs switch regions, then being the only bureau member clearly is an advantage if at least one of the lenders in the other region has also joined the bureau. In this case, the lender has exclusive information in its region and can extract monopoly profits from all identified good entrepreneurs. If the entrepreneurs remain in their initial sectors, nothing is lost from joining, as the competitor in the other sector of the region has not joined and will not receive any information. If no other lender joins the credit bureau, a lender can neither benefit nor lose from joining the bureau. ii) If a lender's direct competitor joins, information sharing has beneficial and adverse effects. Whether the net effect of joining is positive or negative depends on three factors: The mobility of borrowers (α), the market power of lenders in their home market (T) and the number of joining lenders in the other region. The net effect of information sharing is more likely to be positive if entrepreneurs switch their location very often, if lenders have strong market power and if the non-competing lenders of the other region join the credit bureau.

Having characterized the best response behavior of the second-mover in each region it is straight forward to characterize profit-maximizing behavior of the first-mover:

Lemma 2. (first-mover behavior) *i) The first-mover lender in a region is strictly better off by joining the credit bureau if at least one non-competing lender also joins. ii) If neither non-competing lender joins, the second-mover lender is indifferent between joining and not.*

Proof. If the first-mover does join the credit bureau he knows that the second-mover will also join if $(Y_g - I)(1 - \alpha) \leq (1 - \alpha + \gamma\alpha)T$, where $\gamma \in \{0; 0.5; 1\}$ is the share of non-competing lenders that join. Given that under these conditions the second-mover finds it profitable to join and payoffs of lenders are symmetric, the first-mover must also be better off by joining the bureau. If $(Y_g - I)(1 - \alpha) > (1 - \alpha + \gamma\alpha)T$, the second-mover would not join after the first-mover joins and the first-mover is at least better off by joining the credit bureau than by not doing so. He is strictly better off if at least one non-competing lender joins $\gamma \in \{0.5; 1\}$ (see proof of Lemma 1). \square

Lemma 1 and 2 allow us to characterize the full set of Nash equilibria for our game, depending on the “mobility” of entrepreneurs α and intra-regional transaction costs. It is straightforward to see that for all combinations of parameters there exists an equilibrium in which no lender joins the credit bureau. If no other lender joins the credit bureau it is a (weakly) best response for the remaining lender not to join as well. However, the no sharing equilibrium is not trembling hand perfect in the sense of Selten (1975).³ We therefore neglect these equilibria in the rest of the paper.

Proposition 1 summarizes the conditions under which full sharing of information (two lenders per region join the credit bureau) can be sustained. The proposition shows that full information sharing can be sustained if borrowers are sufficiently mobile (high α) and the competition from other lenders is weak enough (high transaction costs T).

Proposition 1. *There exists a Nash equilibrium in which all lenders join the credit bureau with certainty if and only if $(Y_g - I)(1 - \alpha) \leq T$.*

Proof. If both non-competitor lenders join the credit bureau we have $\gamma = 1$. Now consider the best response of the second-mover lender in region A if the first-mover has joined the credit bureau. From Lemma 1 it is clear that with $\gamma = 1$ the best-response for the lender is to join if $(Y_g - I)(1 - \alpha) \leq T$. Furthermore, from Lemma 2 we know that if both non-competing lenders join the credit bureau, the first-mover lender is strictly better off by joining as well. \square

Proposition 2 summarizes the conditions under which partial sharing of information (one lender per region joins the credit bureau) can be sustained in equilibrium. The proposition shows that when the market power of lenders in their home sector is weak

³Intuitively, the problem can be understood as follows: In the no sharing equilibrium all played strategies are only weakly best responses, i.e., if no other lender joins, lenders are indifferent between joining and not joining. Thus, if we assume that the lenders through a “slip of the hand” or tremble may choose unintended strategies with a negligible but positive probability, then not joining is strictly dominated by joining. In different words, if there is only the slightest probability that one of the lenders in the other region may join, no sharing is no longer an equilibrium.

and/or when borrowers are rather immobile, equilibria exist in which a lender only shares information with other lenders who are not direct competitors.

Proposition 2. *There exists a Nash equilibrium in which only one lender per region joins the credit bureau if and only if $(Y_g - I)(1 - \alpha) > (1 - \frac{1}{2}\alpha)T$.*

Proof. Suppose that one non-competing lender joins the credit bureau so that $\gamma = \frac{1}{2}$. Now consider the best response of the second-mover lender if the first-mover has joined the credit bureau. From Lemma 1 it is clear that with $\gamma = \frac{1}{2}$ the best-response for the lender is not to join if $(Y_g - I)(1 - \alpha) > (1 - \frac{1}{2}\alpha)T$. From Lemma 2 we further know that if one non-competing lender joins the credit bureau, the first-mover lender is strictly better off by joining as well. \square

Proposition 1 replicates the main findings of Pagano and Jappelli (1993): full information sharing by all our experimental lenders is positively related to the “mobility” of borrowers and negatively related to competition in the credit market. In contrast to their analysis, however, spatial competition between lenders in our experiment yields two additional important predictions:⁴

1. When market conditions cannot sustain full information sharing of all lenders, there exist partial sharing equilibria in which lenders exchange information only with non-competitors (see Proposition 2).
2. Even when full information sharing can be sustained, partial information sharing may arise due to a “coordination failure” among non-competing lenders. Comparing Propositions 1 and 2 we see that there exists a range of parameters $(G - I)(1 - \alpha) < T < (G - I)(1 - \alpha)\frac{2}{2 - \alpha}$ for which both full-sharing and partial-sharing of information among lenders is feasible.⁵

The intuition for the first result comes from the fact that in our type of spatial competition it doesn’t hurt to share information with non-competitors. As soon as at least one lender in the other region joins there is a strict incentive for at least one lender in a region to join as well, i.e., there must always be an equilibrium in which at least two non-competing lenders join the credit bureau. An alternative type of spatial competition would be to assume symmetric, imperfect competition with costs of $c = T$ for all cross-sectoral transactions. In this case we would yield for each parameter constellation

⁴Pagano and Jappelli (1993) do assume in their model that some lenders are more distant than others, but do not analyze the consequences of this assumption for information sharing equilibria.

⁵For the same range of parameters there also exists one mixed-strategy equilibrium. In this equilibrium the first-movers in both regions join the bureau, while the second-movers both join with a positive probability.

either a unique full-sharing or a no-sharing equilibrium.⁶ Despite the improvements in communication technology we believe, however that the assumption of “differentiated” competition among lenders is more realistic than to assume that all lenders compete with each other at the same intensity. Degryse and Ongena (2005) for example, showed recently that distance between firms, lenders, and competitor lenders strongly influence loan terms in Belgium.

The intuition for the second result comes from the fact that under spatial competition the value of joining the credit bureau depends on how many non-competitors join. Under some parameter constellations it can be the case that both lenders in a given region will only join if both non-competing lenders from the other sector join, but not if only one of them is a member of the credit bureau. There thus exists the potential for “coordination failure” among non-competing lenders, leading to multiple equilibria for a considerable range of parameter constellations. Note that this second result relies not only on spatial competition, but also on our assumption that the decisions to join the credit bureau are simultaneous across regions. If the decisions of lenders to join the credit bureau are made fully sequentially, the potential for “coordination failure” between non-competing lenders does not arise. However, fully sequential joining decisions imply that all lenders can perfectly observe the behavior of all other potential members of the credit bureau. It is rather unlikely that this will be the case in reality. Another interpretation of fully sequential moves, is that a third party can credibly announce that he will approach all potential members sequentially, and that they will be fully bound by their promises to exchange information. In practice, private entrepreneurs do perform this task, and are instrumental in establishing reciprocal credit bureaus (for example Experian or CRIF in Eastern Europe). However, it is highly unlikely that all lenders believe that all other lenders will be approached *and* will abide by their promises to join.⁷

⁶To see this, suppose that it is the best response for lender j to join the credit bureau if one other lender i also joins. In this case it must be profit-maximizing for both other lenders in the credit market also to join the bureau, as the benefits of joining increase with the number of other participants while the costs do not. Thus if all lenders compete with each other (imperfectly at transaction costs T), there exists for each parameter constellation either a unique full-sharing or a no-sharing equilibrium.

⁷Note that our predictions are not affected if we assume that lenders make completely simultaneous decisions, i.e., joining decisions are not only made simultaneously across regions but also within regions. The only difference is the following: With completely simultaneous decisions with respect to information sharing it is not determined which of the two lenders in a region joins the credit bureau in a partial sharing equilibrium. If the decision to join is taken sequentially within each region, then the first-mover will join the credit bureau and the second-mover will not, i.e., simultaneous decisions within regions create a coordination problem for the lenders in a region, but do not affect individual incentives to join the credit bureau.

3.3 Predictions by treatment

Applying Proposition 1 we see that a full-sharing equilibrium, i.e., 2 lenders per region join the credit bureau is feasible in three of our four treatments. The condition $(Y_g - I)(1 - \alpha) \leq T$ is fulfilled in the “LowMobility-LowCompetition” treatment ($\alpha = .25$; $T = 160$), in the “HighMobility-HighCompetition” treatment ($\alpha = .75$; $T = 60$), and in the “HighMobility-LowCompetition” treatment ($\alpha = .75$; $T = 160$). Full-sharing is not feasible in our “LowMobility-HighCompetition” treatment ($\alpha = .25$; $T = 60$). By applying Proposition 2 we further see that a partial-sharing equilibrium, i.e., only 1 lender per region joins the credit bureau, is feasible in three of our four treatments. The condition $(Y_g - I)(1 - \alpha) \geq (1 - \frac{1}{2}\alpha)T$ is fulfilled in the “LowMobility-LowCompetition”, “HighMobility-HighCompetition”, and “LowMobility-HighCompetition” treatments. Partial-sharing is, however, not feasible in our “HighMobility-LowCompetition” treatment.

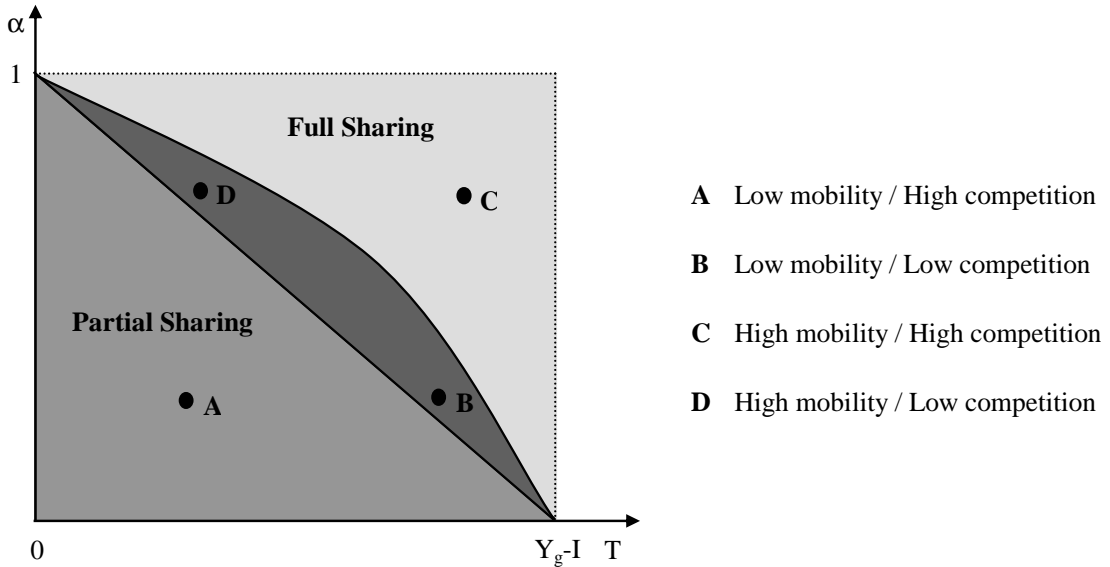


Figure 2: Market Equilibria

Figure 2 displays the predictions for our experiment and illustrates the rationale behind our choice of treatments. We implement two benchmark treatments in which only one equilibrium type is feasible. In the “HighMobility-LowCompetition” treatment lenders have little to lose and lots to gain from sharing information, and we therefore expect full information sharing (2 lenders per region). The opposite case is the “LowMobility-HighCompetition” treatment, where lenders have lots to lose and little to gain from sharing information. Here we expect that lenders will never share information with their competitors, so that only partial information sharing takes place (1 lender per region).

In the “HighMobility-HighCompetition” and “LowMobility-LowCompetition” treatments both full information sharing and partial sharing are feasible. These two treatments allow us to compare the relative impact of adverse selection and lender competition on voluntary information sharing. If we find that full information sharing dominates the outcome in the “HighMobility-HighCompetition” treatment, while partial sharing is most frequent in the “LowMobility-LowCompetition” treatment, our results would suggest that lender competition has less impact on information sharing than the degree of adverse selection. In contrast, if partial information sharing dominates in the “HighMobility-HighCompetition” treatment while full information sharing dominates the “LowMobility-LowCompetition” treatment, our results would suggest that lender competition has more impact on information sharing than the degree of adverse selection.

4 Results

4.1 Information Sharing

We analyze information sharing by region as we have predictions for behavior at the region level. In the “HighMobility-LowCompetition” treatment 2 lenders per region should join the credit bureau, while in the “LowMobility-HighCompetition” treatment only 1 lender per region should join. Our results confirm the predictions for these benchmark treatments. Figure 3 displays the frequency with which both lenders, 1 lender, or no lender in a region join the credit bureau.⁸ In the “HighMobility-LowCompetition” treatment, full information sharing is the dominant outcome. Here, two lenders per region join the credit bureau in 82% of the cases, while in just 16% of the cases only one lender per region joins the bureau. In contrast, in the “LowMobility-HighCompetition” treatment two lenders of the same region join the bureau only 14% of the time, while the frequency of partial information sharing is 67%. A Mann-Whitney test comparing session outcomes confirms that full information sharing is significantly more frequent in the “HighMobility-LowCompetition” than in the “LowMobility-HighCompetition” treatment.⁹

We do not have clear-cut predictions for our two other treatments. In the “LowMobility-LowCompetition” and the “HighMobility-HighCompetition” treatment, where both partial sharing (1 lender per region) as well as full sharing (2 lenders per

⁸In each treatment $n=600$. For each treatment we conducted 5 sessions of 20 periods each. In each period of each session there are 2 regions in each of the 3 markets.

⁹In the 5 sessions of the “HighMobility-LowCompetition” treatment the number of instances of full information sharing (out of possible 120 per session) was 85, 96, 97, 105, 110 respectively. In the 5 sessions of the “LowMobility-HighCompetition” treatment the number of instances of full information sharing was 12, 14, 16, 16, 24 per session respectively. A one-sided rank-sum test comparing session outcomes thus yields $p = .004$.

region) can be sustained. Astonishingly, lender behavior in the two treatments differs substantially. In the “HighMobility-HighCompetition” treatment full sharing of information is the most frequent outcome, occurring 72% of the time. In stark contrast, we find that partial information sharing is the dominant outcome in the “LowMobility-LowCompetition” treatment. Figure 3 shows that in this treatment both lenders of a region join the credit bureau 24% of the time, while only one lender joins 64% of the time. A statistical analysis confirms that full sharing is significantly less frequent in the “LowMobility-LowCompetition” than in the “HighMobility-HighCompetition” treatment.¹⁰

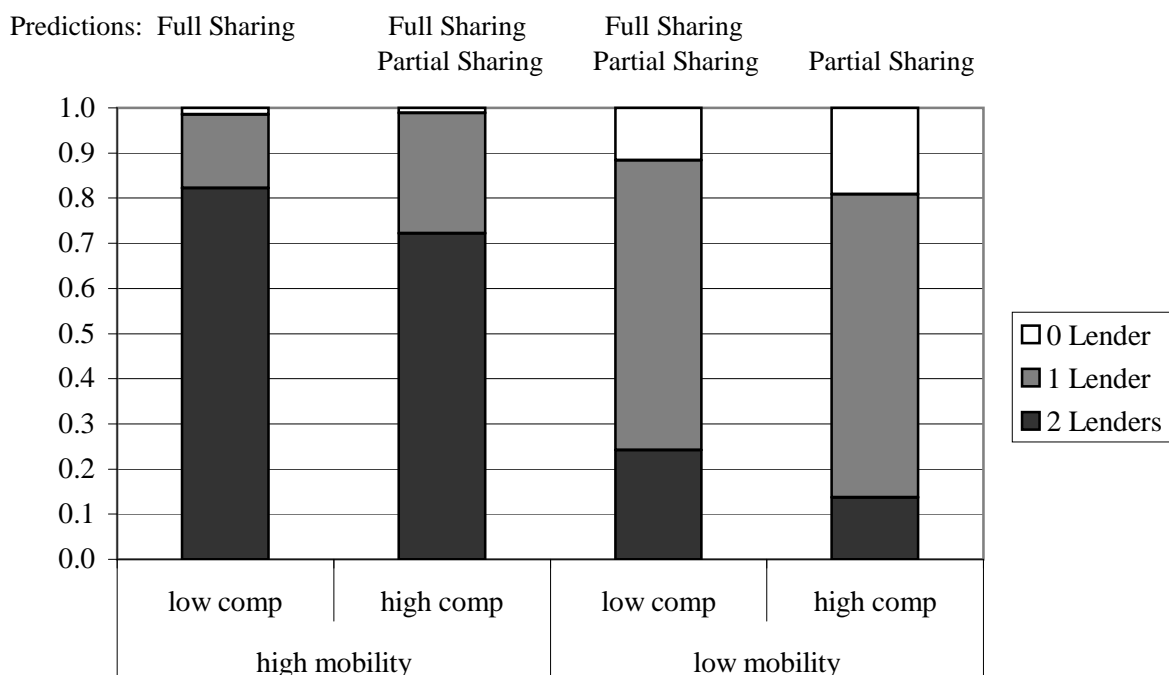


Figure 3: Frequency of credit bureau participation

How can we explain the different behavior of lenders in the “LowMobility-LowCompetition” compared to the “HighMobility-HighCompetition” treatment? One potential explanation is that our experimental design was successful in implementing varying levels of adverse selection, but failed to implement varying levels of lender competition. Our design may fail to manipulate competition levels, if lenders in a given region “agree”

¹⁰In the 5 sessions of the “LowMobility-LowCompetition” treatment the number of instances of full information sharing (out of possible 120 per session) was 20, 28, 30, 31, and 36 respectively. In the 5 sessions of the “HighMobility-HighCompetition” treatment the number of instances of full information sharing was 68, 85, 90, 91, and 99 respectively. A two-sided Mann-Whitney test comparing session outcomes thus rejects the hypothesis that full information sharing is equally frequent in the “LowMobility-LowCompetition” and “HighMobility-HighCompetition” treatments ($p = .008$).

not to poach each others' good borrowers. In this case our variation of cross-sector transaction costs would not affect lenders' profits at all, and would thus not alter information sharing incentives. Tacit collusion among lenders might therefore explain the modest impact of cross-sector transaction costs on information sharing incentives. Table 2 shows, however, that collusion among lenders cannot explain the limited impact of transaction costs T on information sharing. The table shows that a lender's profits from extending credit to a good borrower depended strongly on whether the competing lender in the same region also knew which borrower was good. Table 2 displays the mean repayment levels paid by good borrowers in our four treatments. The table shows that if only one lender in a region knows that a particular borrower is good, then this lender earns a monopoly profit. By design, the maximum repayment lenders can demand from borrowers was 300 (this was the certain investment earning of good borrowers). In all four treatments, good borrowers pay repayment levels close to 300, if only one lender can identify their type. If, in contrast, both lenders in a region can identify a good borrower, competition drives repayment demands down. The lowest repayment which the lender in the same sector as the borrower can demand (and make non-negative profits) is the cost of funds 100. Due to transaction costs T of lending across sector borders, the lowest repayment which the lender in the other sector of the region can demand (and make non-negative profits) is $100 + T$. If both lenders can identify the same good borrower, competition should thus lower repayment demands to $100 + T$. In the "High Competition" treatments ($T = 60$) this implies a level of 160, while in the "Low Competition" treatments ($T = 160$) it implies a repayment level of 260. Table 2 shows indeed that repayments paid by good borrowers are close to these competitive levels, when both lenders in a region can identify a good borrower.

Table 2: Mean repayments in contracts accepted by good borrowers

Treatment	Number of lenders who know borrower type	
	1	2
LowMobility-HighCompetition	293	182
LowMobility-LowCompetition	296	234
HighMobility-HighCompetition	281	176
HighMobility-LowCompetition	287	238

Given that our experiment design does successfully implement different levels of competition in the "LowMobility-LowCompetition" and "HighMobility-HighCompetition" treatments, our predictions offer only one explanation for the difference in observed information sharing behavior: The two treatments generate different beliefs about the behavior

of non-competing lenders. In both treatments it is payoff-maximizing for both lenders in region A to join the credit bureau, if they expect that the two non-competing lenders in region B also join. If, however, they believe that only one non-competitor from region B shares information, then the best response of the second lender in region A is not to join the credit bureau. Our results suggest that the degree of borrower mobility coordinates the beliefs among non-competing lenders regarding information sharing. When mobility is high, all lenders believe that both non-competing lenders will join the credit bureau. This makes information sharing the best response behavior for each lender. In contrast, when mobility is low, lenders apparently believe that only one non-competing lender will join the credit bureau: This makes information sharing the best response behavior only for one lender per region.

An analysis of credit bureau participation over time shows that the difference in information sharing behavior between the “HighMobility-HighCompetition” and the “LowMobility-LowCompetition” treatment displayed in Figure 3 emerges already at the beginning of our experiment. During the initial phase of the experiment (periods 1 to 5) the incidence of full information sharing in the “HighMobility-HighCompetition” treatment already reaches 71%. In the “LowMobility-LowCompetition” treatment, on the other hand, partial information sharing dominates already in the initial phase of the experiment. During periods 1 to 5 in this treatment only one lender per region joins the bureau in 60% of the cases. This result suggests that the degree of borrower mobility coordinates information sharing behavior from the outset of the experiment. In addition, the difference in information sharing between the two treatments increases steadily over time. In the “HighMobility-HighCompetition” treatment the frequency of full information sharing remains stable at roughly 70% over the course of the experiment. In contrast, the frequency of partial information sharing in the “LowMobility-LowCompetition” treatment increases steadily over the course of the experiment, reaching more than 70% during periods 16-20.

Table 3 shows that the difference in information sharing behavior between the “LowMobility-LowCompetition” and the “HighMobility-HighCompetition” treatment is individually rational. The table displays the profits yielded by each lender, depending on his decision to join the credit bureau, and on the decision of the competing lender in the same region. The table shows that in the “LowMobility-LowCompetition” treatment a lender yields a higher profit by not joining the credit bureau if his competitor does join. For this treatment, therefore, partial sharing of information is individually rational. In contrast, in the “HighMobility-HighCompetition” treatment a lender does not make any losses if he shares information, even when his direct competitor also joins the credit bureau. For this treatment full sharing of information is thus individually rational.

Table 3: Information sharing and lenders' profits

Competitor's decision Lender's decision	not join		join	
	not join	join	not join	join
LowMobility-LowCompetition	344	365	338	267
HighMobility-HighCompetition	177	414	243	244

Our results above suggest that when multiple levels of information sharing exist, lender's market power plays a negligible role in coordinating lenders beliefs about information sharing. This does not, however, imply that credit market competition has no impact on information sharing at all. Figure 3 shows that full sharing does occur less often in the "HighMobility-HighCompetition" treatment than in the "HighMobility-LowCompetition" treatment.¹¹ Moreover, full information sharing of information is, slightly more frequent in the "LowMobility-LowCompetition" than in the "LowMobility-HighCompetition" treatment.¹²

4.2 Efficiency

What is the impact of information sharing on credit market performance in our experiment? We measure credit market performance by the total gains from trade generated through credit contracts. Defining $X_{g,s}$ ($X_{b,s}$) as the number of loans extended to good (bad) entrepreneurs in the same sector, $X_{g,r}$ ($X_{b,r}$) as the number of loans extended to good (bad) entrepreneurs in the other sector of the same region, and T as the transaction costs of cross-sector lending, total gains from trade are given by: $(Y_g - I)X_{g,s} + (Y_g - I - T)X_{g,r} - IX_{b,s} - (I + T)X_{b,r}$. Note that the maximum volume of gains from trade in each credit market would be yielded, if all good borrowers accepted a credit contract from the lender in their respective sectors and no offers were made to bad

¹¹This difference is, however, only of borderline significance. In the 5 sessions of the "HighMobility-HighCompetition" treatment the number of instances of full information sharing (out of possible 120 per session) was 68, 85, 90, 91, and 99 respectively. In the 5 sessions of the "HighMobility-LowCompetition" treatment the number of instances of full information sharing was 85, 96, 97, 105 and 110 respectively. A one-sided Mann-Whitney test comparing session outcomes thus rejects the hypothesis that full information sharing is more frequent in the "HighMobility-LowCompetition" treatment ($p = .075$).

¹²In the 5 sessions of the "LowMobility-LowCompetition" treatment the number of instances of full information sharing (out of possible 120 per session) was 20, 28, 30, 31, and 36 respectively. In the 5 sessions of the "LowMobility-HighCompetition" treatment the number of instances of full information sharing was 12, 14, 16, 16, 24 per session respectively. A one-sided Mann-Whitney test comparing session outcomes confirms the hypothesis that full information sharing is more frequent in the "LowMobility-LowCompetition" treatment ($p = .008$).

borrowers.¹³ The level of efficiency in each treatment thus depends on two things: Do lenders only offer credit contracts to entrepreneurs they know are good? And how often do lenders know which entrepreneurs in their sector is good? The first issue depends only on the rationality of lenders credit offers. The second depends on the frequency with which entrepreneurs switched location in each treatment, and whether information sharing between lenders could “compensate” for the loss of information due to switching.

Our results shows that lenders credit offers are very rational in all four of our treatments. Table 4 displays the probability of a lender making a credit offer depending on his information about a borrower. Each lender in our experiment can make (at most) two credit offers in every period of the experiment. These offers can be addressed to any of the eight borrowers in the same region of the credit market as the lender. When a lender cannot identify the type of a borrower, he only offers him a loan 3% of the time. In contrast, if a lender knows that a particular borrower is good, he offers him credit in 97% of the cases. Lenders in our experiment thus only make credit offers to borrowers who they know will repay a loan.

Table 4: Information and Credit Offers

Treatment	No Information		Information: bad		Information: good	
	n	$p(\text{offer})$	n	$p(\text{offer})$	n	$p(\text{offer})$
LowMob.-HighComp.	4'896	0.02	3'528	0.00	1'176	0.99
LowMob.-LowComp.	4'352	0.01	3'936	0.00	1'312	0.97
HighMob.-HighComp.	2'224	0.05	5'532	0.00	1'844	0.97
HighMob.-LowComp.	1'496	0.03	6'078	0.00	2'026	0.94
Total	12'968	0.03	19'074	0.00	6'358	0.97

Notes: The top row of the table displays what the lender knows about the entrepreneur’s type. $p(\text{offer})$ measures the probability that a lender makes a credit offer to the entrepreneur given his information. n stands for the number of observations.

Given that lenders in all four treatments only make credit offers to good entrepreneurs, differences in market efficiency across treatments depend only on differences in information conditions of lenders when making their credit offers. In treatments with high mobility, lenders are more likely to face entrepreneurs which they cannot identify by themselves. Do lenders manage to fully compensate this informational disadvantage in high mobility

¹³We run 5 sessions of each treatment with 20 periods each. In each of these periods there are 3 credit markets with 1 good borrower in each of the 4 sector, giving us a total of 1'200 efficient contracts per treatment. Each of these contracts would yield gains of trade of 200 points. The maximum gains from trade in each treatment is thus 240'000 points.

treatments through higher levels of voluntary information sharing? Our results suggest that they do. Table 5 displays the aggregate efficiency achieved in each treatment as a percentage of these potential gains from trade. The table shows that efficiency is high in all four of our treatments, ranging from 70% to 80% of potential gains from trade.

The high level of efficiency reported in Table 5 is not that surprising in markets with low borrower mobility ($\alpha = .25$). Even if no information sharing took place in these treatments, lenders are, on average, able to identify the good borrower in their own sector in 75% of all cases. Credit market performance is, however, surprisingly strong in the “high mobility” treatments ($\alpha = .75$). Without information sharing in these treatments, lenders can, on average, only identify the good borrower in their sector 25% of the time. The table suggests that when lenders face such high borrower mobility, information sharing overcomes the potential loss in credit market performance. For either level of credit market competition, efficiency is slightly lower in “high mobility” treatments than in “low mobility treatments”. However, Mann-Whitney tests comparing session averages reject the hypothesis that higher borrower mobility leads to lower credit market performance.¹⁴ Our experimental results thus suggest that, when necessary, lenders are able to overcome substantial information asymmetries in the credit market, through voluntary information sharing.

Table 5: Credit market performance

Treatment	Contract Type*				T^\dagger	Efficiency
	$X_{g,s}$	$X_{g,r}$	$X_{b,s}$	$X_{b,r}$		
LowMobility-HighCompetition	923	120	29	43	60	0.80
LowMobility-LowCompetition	890	159	32	16	160	0.74
HighMobility-HighCompetition	677	406	65	23	60	0.76
HighMobility-LowCompetition	797	307	30	7	160	0.70

* $X_{g,s}$ ($X_{b,s}$) = contracts accepted by good (bad) borrowers from lender in same sector.

$X_{g,r}$ ($X_{b,r}$) = contracts accepted by good (bad) borrowers from lender in other sector.

$^\dagger T$ = transaction costs of cross-sector lending.

¹⁴In the 5 sessions of the “LowMobility-LowCompetition” treatment the efficiency levels are .71, .71, .73, .75, .78 respectively. In the 5 sessions of the “HighMobility-LowCompetition” treatment the efficiency levels are .62, .69, .69, .74, .75 respectively. A one-sided Mann-Whitney test comparing session outcomes thus rejects the hypothesis that credit market performance is lower in the “HighMobility-LowCompetition” treatment ($p = .111$).

In the 5 sessions of the “LowMobility-HighCompetition” treatment the efficiency levels are .74, .76, .79, .84, .86 respectively. In the 5 sessions of the “HighMobility-HighCompetition” treatment the efficiency levels are .72, .74, .76, .79, .79 respectively. A one-sided Mann-Whitney test comparing session outcomes thus rejects the hypothesis that credit market performance is lower in the “HighMobility-HighCompetition” treatment ($p = .155$).

5 Conclusions

In this paper we examine how potential adverse selection and credit market competition in credit markets affect reciprocal information sharing between lenders. Our experimental results confirm that information sharing is positively related to the degree of information asymmetry and negatively related to the intensity of lender competition. When competition is weak and information asymmetries strong, we find full sharing of information among our experimental lenders. In contrast, when competition is strong, and information asymmetries weak, lenders share information only with non-competitors, leading to a partial-sharing equilibrium.

Our results suggest further that potential adverse selection in the credit market is more important than lender competition when it comes to coordinating the information sharing behavior of lenders. We implement two experimental treatments in which both full, and partial information sharing are feasible, due to a coordination problem among non-competing lenders. In one of these treatments adverse selection is strong, and we find a very high level of voluntary information sharing. In the other treatment adverse selection is weak, and lenders only share information with non-competitors.

Our findings may explain a puzzling development in credit markets over the past two decades: Voluntary information sharing through private credit bureaus has grown most rapidly in the consumer credit market, although this market is highly competitive in most countries. Our results suggest that information sharing may be high in the consumer credit market despite strong competition, because this market segment is subject to substantial information asymmetries due to borrower mobility etc. Under this circumstance, lender competition is only of minor importance in determining credit bureau participation, while the information problem coordinates the efforts of lenders.

References

- Barron, J. M. and M. Staten (2003): “The Value of Comprehensive Credit Reports: Lessons from the U.S. Experience”, in M.J. Miller (ed.), *Credit Reporting Systems and the International Economy*, Boston: MIT Press.
- Bouckaert, J. and H. Degryse (2006): “Entry and Strategic Information Display in Credit Markets”, *Economic Journal*, 116, 702-720.
- Brown, M. and C. Zehnder (2006): “Credit Reporting, Relationship Banking, and Loan Repayment”, *Swiss National Bank Working Paper* 2006-03.
- Brown, M. and T. Jappelli, and M. Pagano (2007): “Information Sharing and Credit Market Performance: Firm-Level Evidence from Transition Countries”, *Mimeo*.
- Degryse, H. and S. Ongena (2005): “Distance, lending relationships, and Competition”, *The Journal of Finance*, 60 (1), 231-266.
- Djankov, S., C. McLiesh and A. Shleifer (forthcoming): “Private Credit in 129 Countries”, *Journal of Financial Economics*.
- Fischbacher, U. (forthcoming): “z-Tree: Zurich Toolbox for Readymade Economic Experiments”, *Experimental Economics*.
- Galindo, A. and M. J. Miller (2001): “Can Credit Registries Reduce Credit Constraints? Empirical Evidence on the Role of Credit Registries in Firm Investment Decisions”, Paper prepared for the Annual Meetings of the Inter-American Development Bank, Santiago Chile.
- Hunt R. (2005): “A Century of Consumer Credit Reporting in America”, *Federal Reserve Bank of Philadelphia Working Paper* 05-13.
- Jappelli, T. and M. Pagano (2002): “Information Sharing, Lending and Defaults: Cross-Country Evidence”, *Journal of Banking & Finance*, 26, 2017-2045.
- Kallberg, J. G., and G. F. Udell (2003): “The Value of Private Sector Credit Information”, *Journal of Banking & Finance*, 27, 449-469.
- Klein, D. B. (1992): “Promise Keeping in the Great Society: A Model of Credit Information Sharing”, *Economics and Politics*, Vol.4(2), 117-136.
- Love I., and N. Mylenko (2003): “Credit Reporting and Financing Constraints”, *World Bank Policy Research Working Paper* 3142.

- Luoto, J., C. McIntosh, and B. Wydick (2004): “Credit Information Systems in less-Developed Countries: Recent History and a Test”, Working Paper University of California at San Diego / University of San Francisco.
- Olegario R. (2003): “Credit Reporting Agencies”, in M.J. Miller (ed.), *Credit Reporting Systems and the International Economy*, Boston: MIT Press.
- Padilla, A. J. and M. Pagano (2000): “Sharing Default Information as a Borrower Discipline Device”, *European Economic Review* 44 (10), 1951-1980.
- Pagano, M. and T. Jappelli (1993): “Information Sharing in Credit Markets”, *The Journal of Finance*, 43(5), 1693-1718.
- Powell, A., N. Mylenko, M. Miller, and G. Majnoni (2004): “Improving Credit Information, Bank Regulation and Supervision: On the Role and Design of Public Credit Registries, World Bank Policy Research Working Paper 3443.
- San José Riestra, A. (2002): “Credit Bureaus in Today’s Credit Markets”, ECRI Research Report 4/2002.
- Selten, R. (1975): “A Reexamination of the Perfectness Concept for Equilibrium Points in Extensive Games”, *International Journal of Game Theory*, 4, 25-55.
- Vercammen, J. A. (1995), “Credit Bureau Policy and Sustainable Reputation Effects in Credit Markets”, *Economica*, 62, 461-478.

Appendix A: Proof of Lemma 1

Consider first the decision of a lender, given that its competitor in the same region does not join the credit bureau:

- If the lender does not join the credit bureau and the entrepreneurs do not switch regions, he will seal a credit contract demand with the good entrepreneur in his home market, thus earning a payoff of $\pi^L = (Y_g - I)$. If the entrepreneurs do switch regions and the lender is not a member of the credit bureau he has no information on any entrepreneurs situated in his region and will thus not lend. As entrepreneurs switch with probability α , the expected payoff from not joining is $E\pi^L = (1 - \alpha)(Y_g - I)$.
- If the lender does join and entrepreneurs do not switch he still earns $\pi^L = (Y_g - I)$ as his competitor has no information on the entrepreneurs in the lender's sector. If the lender joins and entrepreneurs do switch he earns zero profits if neither of the two lenders in the other region of the credit market has joined. The problem is that in this case the lender has no information on any entrepreneurs situated in its region and will thus not lend. If entrepreneurs switch and one of the two lenders in the other region also joins, then a joining lender has information about the entrepreneurs coming from the other bureau member and can seal credit contracts with the good types. Joining therefore results for the lender in either a payoff of $\pi^L = (Y_g - I)$ or $\pi^L = (Y_g - I - T)$, depending on the sector to which the known borrowers from the other region move. As both outcomes are equally likely the expected payoff of the lender from joining, given that one other lender in the other region joins, is $E\pi^L = \frac{1}{2}((Y_g - I) + (Y_g - I - T))$. If entrepreneurs switch and both lenders in the other region of the credit market join, then the lender knows all good entrepreneurs who come to his region and his payoff from joining is given by $\pi^L = (Y_g - I) + (Y_g - I - T)$. Thus, the lender's expected payoff from joining depends on the behavior of the lenders in the other region. However, summarizing we can say that the lenders expected payoff can be characterized by the following expression, $(1 - \alpha)(Y_g - I) + \alpha\gamma(Y_g - I - T)$, where $\gamma \in \{0; 0.5; 1\}$ is the fraction of joining lenders in the other region.

Thus, if a lender's direct competitor does not join the credit bureau, then the lender is therefore indifferent between joining and not joining if both lenders in the other region do also not join. But, if either one or both of the lenders in the other region join, then the lender is strictly better off by joining.

Now consider the decision of a lender, given that its competitor in the same region does join the credit bureau:

- If the lender does not join the credit bureau he will, as above, earn a payoff of $\pi^L = (Y_g - I)$ with the probability $(1 - \alpha)$.
- If the lender does join and entrepreneurs do not switch he will now earn only a payoff of $\pi^L = T$ as his competitor also has information on the entrepreneurs in the lender's sector. If the lender does join and entrepreneurs switch, then the following outcomes are possible: The lender earns a payoff of 0 if neither of the two lenders in the other region has joined and the lender therefore does not have information on any of the borrowers in his region. If one of the two lenders in the other region joins, then the lender earns either a payoff of $\pi^L = T$, if the known entrepreneurs from the other region move to the lender's sector, or $\pi^L = 0$, if the known entrepreneurs from the other region move to the competitor's sector. As both outcomes are equally likely the lender's expected profit in case that only one lender in the other region joins is $E\pi^L = \frac{1}{2}T$. If both lenders in the other region join then the lender's payoff is given by $\pi^L = T$ as he can seal a credit contract with the good entrepreneur that moves to his sector. Summarizing, we can therefore state the lender's expected profit from joining as $E\pi^L = (1 - \alpha)T + \alpha\gamma T$, where $\gamma \in \{0; 0.5; 1\}$ is the fraction of joining lenders in the other region.

If a lender's competitor does join the credit bureau it is therefore a best response for the lender to join if and only if $(1 - \alpha + \alpha\gamma)T > (1 - \alpha)(Y_g - I)$.

This concludes our proof of Lemma 1.